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INVENTION DISCLOSURE

ROI Number _____

Short, Descriptive Title: Decaborane Delivery System

(1) State the PROBLEM or DEFICIENCY which is overcome by your invention:
Decaborane is a solid with a vapor pressure of ~0.2 torr at room temperature. To increase the vapor pressure, heat must be supplied to its container. The evaporation rate of the decaborane in the vaporizer is significantly enhanced by its internal geometry. The internal reservoir is made up of many deep, cylindrical wells. The small cylindrical wells dramatically increase the surface area to contact the solid, therefore more decaborane is vaporized.

(2) Describe clearly the INVENTION, RESULTS, ADVANTAGES. (Make DRAWINGS when possible and DESCRIBE FULLY the invention and its OPERATION using REFERENCE NUMERALS to indicate elements.

A system was needed to provide a constant deliverable flowrate of decaborane to an ion source chamber. Decaborane is a white solid with a vapor pressure of ~0.2 torr at 20°C. The system has to be heated in order to generate enough vapor to induce flow to the source chamber. The system also has to be heated evenly over its geometry in order to prevent decaborane from condensing in a "cold" spot. All lines leading from the delivery system to the ion source chamber must also be heat traced for the same reason.

The system hardware is comprised of an aluminum block 2.5" W x 2.5" L x 5" H with a total internal volume of ~160 cc. The solid holding wells consist of 3/16" ID holes bored into the block and their total volume is ~60 cc. The remaining 100 cc is

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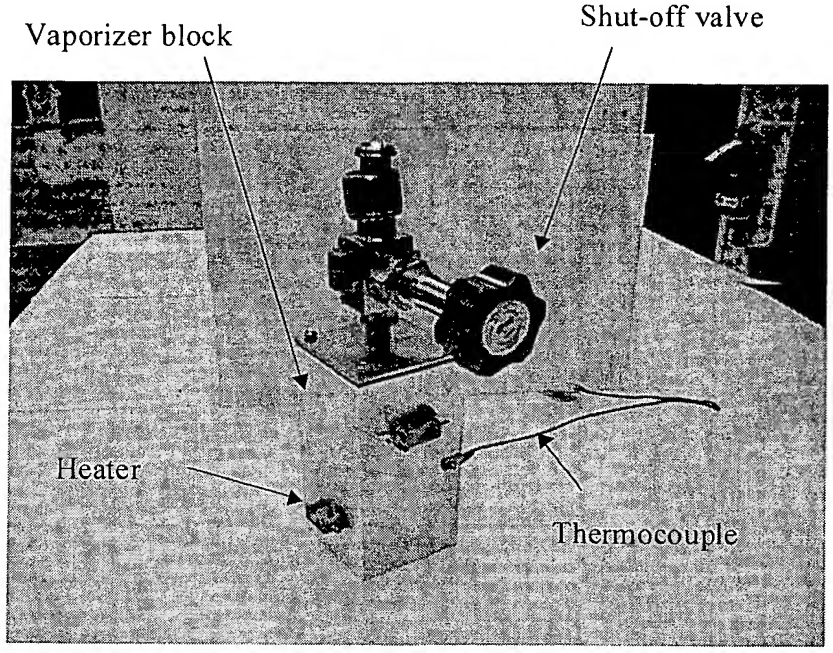
bored out above the reservoirs and serves as a void space for the solid vapor to accumulate. Atop the aluminum block is a shut-off valve and block lid. The stainless steel shut-off valve has a 7.6 mm orifice which provides good conductance for decaborane flow. The lid and valve, which is one piece, is sealed to the block with a viton o-ring and machine screws. A picture of the hardware is shown below.



The reservoir block and shut-off valve are heated by 10 watt resistors. Four resistors are placed an each vertical face of the block and two are placed on the side of the valve block. When current is supplied to the resistors, they heat up and increase the temperature of the vaporizer and valve. The aluminum vaporizer provides excellent thermal conductivity and therefore a uniform temperature profile throughout. The temperature of the vaporizer can be controlled with a temperature controller, 50 watt power supply (2 amp max current) and a solid state relay. A wiring diagram is shown below:

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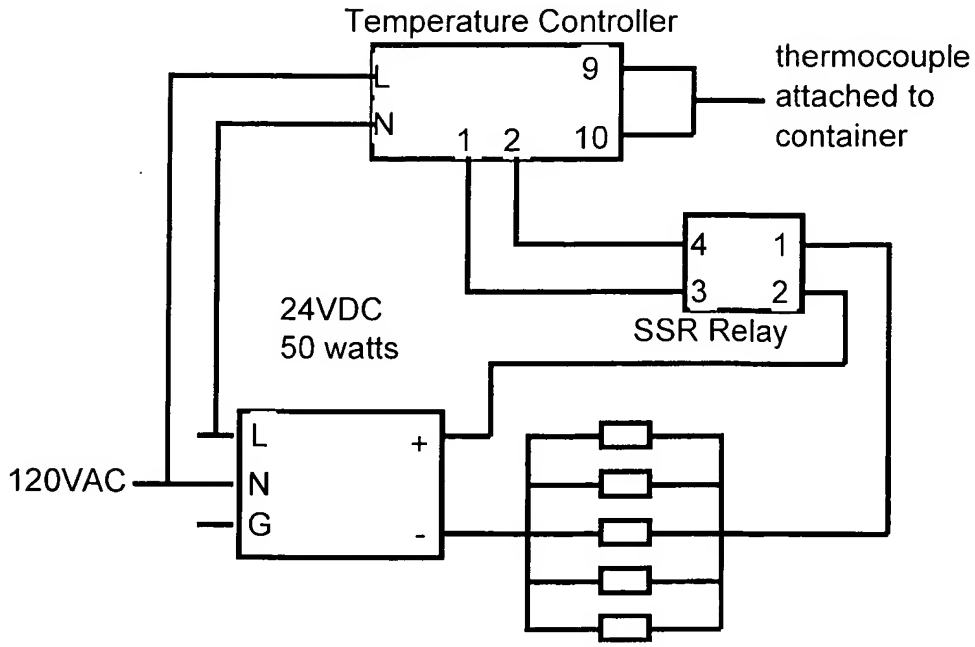

10 Watt resistors attached to container

Depending on the desired temperature, the temperature controller sends a signal to the power supply, through the relay, to either provide more current to the resistors or to power down the resistors. A surface mount type K thermocouple is connected to one of the vertical faces of the block. The maximum external temperature of the resistors is ~120°C with a 2 amp max current power supply.

Once testing is over, it is important to continue to supply power to the resistors on the shutoff valve and to cut power to the resistors on the vaporizer block. This will prevent the decaborane from condensing in and clogging the inlet to the shut-off valve. The decaborane vapor will instead re-condense in the cooler vaporizer block.

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Test data shows that sustainable flowrates of decaborane can be achieved with this system. Tests were conducted using various system temperatures and various orifice diameters. The maximum achievable flowrates are as follows (all temperatures reflect that of the vaporizer):

Through 1/4" OD straight tubing:
@42 C - 0.6 sccm
@52 C - 2.8 sccm
@66 C - 5.1 sccm

Through 1/8" OD straight tubing
@42 C - 0.1 sccm
@52 C - 0.8 sccm
@66 C - 3.6 sccm

Using a Needle valve
@66 C - 0.35 sccm (Cv = 0.004)
@66 C - 4.0 sccm (Cv = 0.055)

(3) Was this invention first conceived or first actually reduced to practice under government contract support? If so, what are the contract name and contract number?

No

(4) Has there been any publication, public disclosure, or offer for sale, or are any contemplated? Provide details, especially dates.

[redacted]

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[redacted]

(5) Laboratory Notebook or Runsheet Number cross reference, including date(s).

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